Klamath Irrigation Project Sucker Salvage and Langell Valley Fish Survey Report - 2000

Brian J. Peck

U.S. Bureau of Reclamation
Mid Pacific Region
Klamath Basin Area Office
6600 Washburn Way
Klamath Falls, Oregon 97603

January 22, 2001

Key words: sucker, endangered fish, Klamath, canal

The correct citation for this report is:

Peck, B. J. 2001. Klamath Irrigation Project sucker salvage and Langell Valley fish survey report - 2000. U.S. Bureau of Reclamation, Klamath Falls, Oregon. Annual report.

SUMMARY

This report presents data collected during 2000 from endangered sucker sampling and salvage operations. Work was performed from September 29 through December 1 at various locations within the Klamath Project. A total of 20 different fish species were encountered. Target species included endangered Lost River suckers *(Deltistes luxatus)* and shortnose suckers *(Chasmistes brevirostris)*, with non-listed Klamath largescale suckers (*Catostomus snyderi*) and redband trout (*Oncorhynchus mykiss*) also being collected. Data analysis focused on length frequency, age class structure, distribution, abundance and species composition.

A total of 8,738 suckers (1,414 shortnose, 90 Lost River, 652 Klamath largescale, 6,567 unknown) and 287 redband trout were captured in all dam and canal salvage and sampling efforts conducted in 2000.

On September 29, October 4 and 13th, 587 suckers (492 shortnose, 65 Lost River, 30 unknown) were salvaged below Clear Lake Dam and relocated to the Lost River at Stevenson Park, Oregon. From October 5 - October 11, on 3 days, sampling was conducted on the North Canal in the Langell Valley Irrigation District (LVID). One unknown sucker and 276 redband trout were captured and relocated to the Lost River at Big Springs, Oregon. On October 11, 6 suckers (1 Klamath largescale, 5 unknown) were captured from the West Canal in the LVID and relocated to the Lost River at Big Springs. One trout and 11 sucker (10 shortnose, 1 unknown) mortalities were observed during these operations.

Fish were salvaged from Klamath Irrigation District (KID) canals between October 16 and November 7. A total of 8,080 suckers (922 shortnose, 25 Lost River, 651 Klamath largescale, 6,470 unknown) and 11 redband trout were captured and released to Upper Klamath Lake at Barkley Springs, Oregon. Eighty-two (1.0% of total) suckers (15 shortnose, 2 Lost River, 27 Klamath largescale, 38 unknown) and 1 redband trout (9.1% of total) died during KID salvage operations.

On November 27 and December 1, salvage was conducted on Tulelake Irrigation District (TID) canals. A total of 64 unknown suckers and one shortnose sucker were collected and relocated to the Lost River immediately downstream of Anderson-Rose Dam, Oregon. No sucker mortalities were observed during TID salvage.

Table of Contents

List of Figures

List of Tables

List of Appendices

INTRODUCTION

Reclamation conducted several fish salvage operations throughout the Klamath Project (Project) during 2000 to minimize take of endangered Lost River and shortnose suckers (Figure 1). This nondiscretionary activity was identified as a Reasonable and Prudent Alternative in the U.S. Fish and Wildlife Service's (Service) Biological Opinion (BO) on the long-term operation of the Klamath Project (USFWS, July 22, 1992). The BO requires Reclamation to conduct annual salvage of endangered suckers stranded in canal systems and below outlet structures of dams within the Project. The BO also requires annual salvage at eight sites that yielded more than 20 suckers (>80 mm in total length) in the 1991 canal salvage operation.

A salvage plan is to be presented to the Service, Oregon Department of Fish and Wildlife (ODFW) and California Department of Fish and Game (CDFG) prior to any salvage operation. Reclamation submitted the 2000 salvage plan to the Service and state resource agencies for review on May 15, 2000. A modified salvage plan was sent on September 8, 2000, notifying the agencies of changes made to the placement of the block net in the forebay of Clear Lake Dam. Also, the Service, ODFW and CDFG were verbally notified prior to commencing salvage activities. See the attached state and federal permits for additional details.

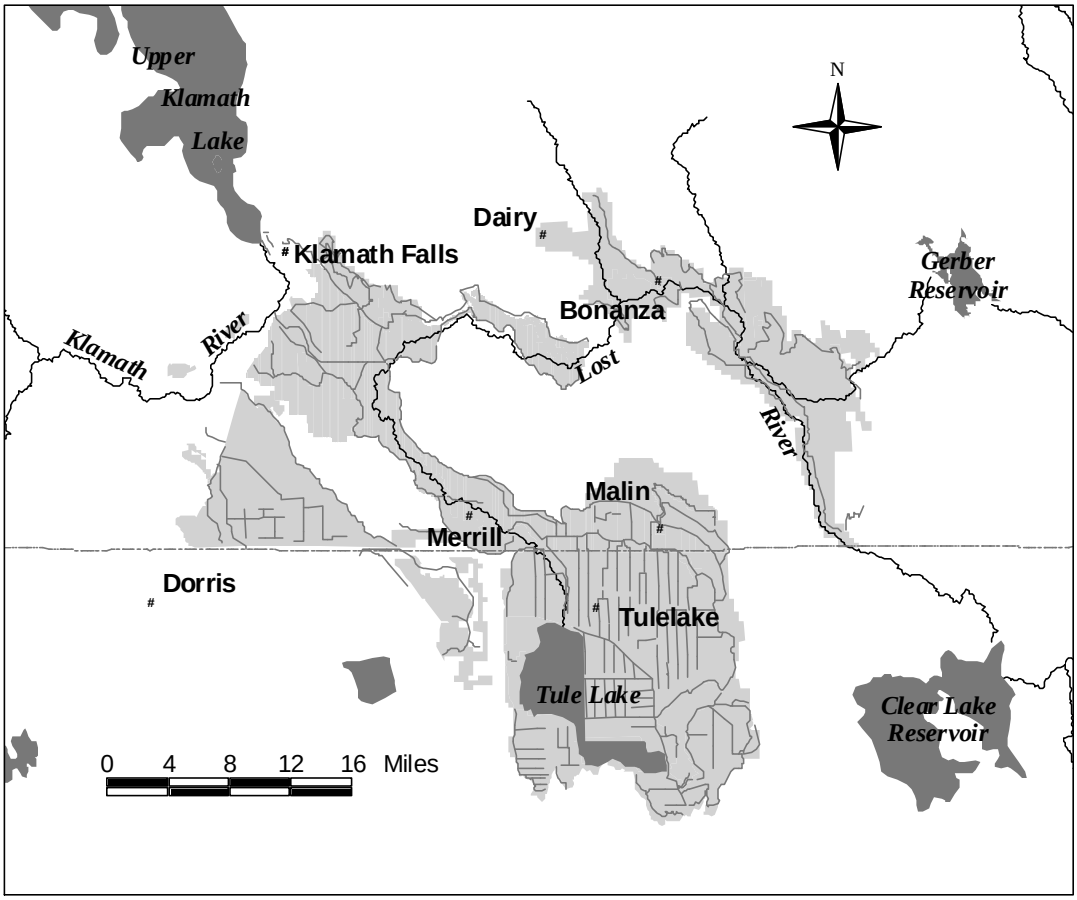

Figure 1. Klamath Project, U.S. Bureau of Reclamation, Oregon and California.

METHODS

Smith-Root model 15-B electrofishers with programmable output waveforms were used to assist in removing fish from the canal system and dam outlets. Pulsed direct current was used with voltage set at 200-400 volts, pulse frequency at 50-60 Hz, and pulse width of 4-7 ms. Crew size ranged from two to eight people, with most sites requiring two electrofishers. Each site was entered on the downstream end and the crew worked slowly upstream. Sites with check structures or head gates were often dry or very shallow (<0.1 m) at the structure, thus preventing fish from swimming upstream.

Salvage operations began as soon as the water levels in the canals were drawn down. Effort was concentrated at pooled areas below drop structures, checks, bridges, and sites where most suckers were found during 1991-1999 salvage operations. Spot-checks were made in open canal sections adjacent to salvage sites. No suckers were captured in areas less than 0.3 m deep and devoid of structure. More than 90% (estimated) of the canals are shallow and lack structure.

Captured suckers and trout were immediately put into five-gallon buckets filled with water and held until salvage at the site was complete or the buckets reached capacity. The fish were then transferred to an oxygenated holding tank in the bed of a pickup truck on site. To reduce stress on fish, the tank was pre-treated with kiln dried salt (5 ppt, no additives) and a protective multilayered slime coating (PolyAqua Professional Fish Protector).

Depending on the quantity of salvaged fish, they were either measured before being transferred to the holding tank or were immediately put into the tank and measured before release. Collected data included: species, sex, fork length (mm), weight (g), passive integrated transponder (PIT) number, and comments on condition. Most suckers <200 mm fork length (FL) were difficult to identify to species and were classified as unknown. All suckers >240 mm were scanned for pre-existing PIT tags, and new tags were implanted ventrally into healthy suckers >300 mm and scanned for identification.

Since 1992, several procedures have been used at the end of the irrigation season to encourage suckers to move to permanent water so they do not have to be salvaged (Lost River, Klamath River). Methods include: accelerated draw-down, flushing and use of bottom drains. These methods involve the rapid lowering of canal water to encourage fish to leave the canal. This was accomplished by adjusting the canal's check gates and spillways to direct flow into open drains leading to the Lost or Klamath Rivers. Canals with bottom drains allow water to be more completely drained.

Maintaining the canals free of debris and aquatic vegetation helps reduce the number of fish remaining in the canals during draw-down. This structure serves as cover for fish. Canals have also been modified in order to more effectively drain. Based on nine years of salvage operations, suckers are rarely found in water depths less than 0.3 m. In the Tule Lake area almost all laterals drain completely except for small pools at headgates.

Collected fish were released at different locations, depending on the capture site. Fish collected from the North and West Canals were released into the Lost River at Big Springs. Suckers salvaged below Clear Lake Dam were released into the Lost River at Stevenson Park. Fish

salvaged from KID canals were released into Upper Klamath Lake at Barkley Springs. Fish salvaged from TID canals were released into the Lost River below Anderson-Rose Dam.

RESULTS and DISCUSSION

North Canal, Langell Valley Fish Survey

From October 5-11, on three days, personnel from Reclamation and the Biological Resources Division of the U.S. Geological Survey sampled the upper half of the 20 mile long canal using electrofishers, block nets and dip nets. The lower 10 miles of canal completely drained or was less than 0.3 m deep.

Prior to commencing salvage, LVID closed the gate at Gerber Dam, thereby stopping flow from the reservoir into Miller Creek. However, spring seeps maintain a small flow within Miller Creek. A gate at the head of the North Canal was also closed, preventing flow from entering the canal. LVID pulled check boards and opened spill gates to further draw-down water in the canal. Bottom topography of the canal prevented water from completely draining, leaving the upper 10 miles (approximate) of canal with water depths ranging from 0.0 - 1.2 m.

A total of one unknown sucker, 276 redband trout, and several dozen sculpin (*Cottus sp.*) and speckled dace (*Rhinichthys osculus*) were collected. Species occurred in the following order of relative abundance, from higher to lower: redband trout, speckled dace, sculpin, yellow perch (*Perca flavescens*), fathead minnow (*Pimephales promelas*), unknown lamprey (*Lampetra sp.*), and unknown sucker. Salvaged fish originated from Miller Creek. However, fish in Miller Creek may have been entrained from Gerber Reservoir or migrated from the Lost River.

A total of 276 redband trout were collected, weighed, and measured in 2000 (Figure 2). Trout ranged from 103 - 442 mm FL, with a mean of 220 mm, and median of 222 mm. Trout weights ranged from 13 – 1,119 g, with a mean of 161 g, and median of 144 g (Figures 2 & 3). The one unknown sucker measured 152 mm FL and weighed 43 g.

Several year classes of redband trout were captured in 2000 (Figure 3). Based on scale analysis, two groups of trout between 103 - 132 mm and 133 - 172 mm, correspond to 0+ and 1+ year classes respectively. Length frequency is not useful in distinguishing year classes for larger fish because growth rates are extremely variable.

In 2000, twenty-one trout (8%) were young-of-the-year (0+), whereas in 1999, 359 trout (87%) were 0+, and in 1998, 86 trout (58%) were 0+ (Figure 2). The variation in the percentage of 0+ trout captured each year may be the result of several factors. One possible explanation is that more spawning habitat is made available to adult trout in Miller Creek at high flows, thereby producing a greater number of 0+ trout. High flows (>300 cfs monthly average) were released from Gerber Dam during the winter and early spring of 1998 and 1999, whereas there were minimal (2 cfs) releases made during this time period in 2000 (Figure 4). Another possibility is that a greater number of 0+ trout are flushed from Gerber Reservoir into Miller Creek during these high flow events.

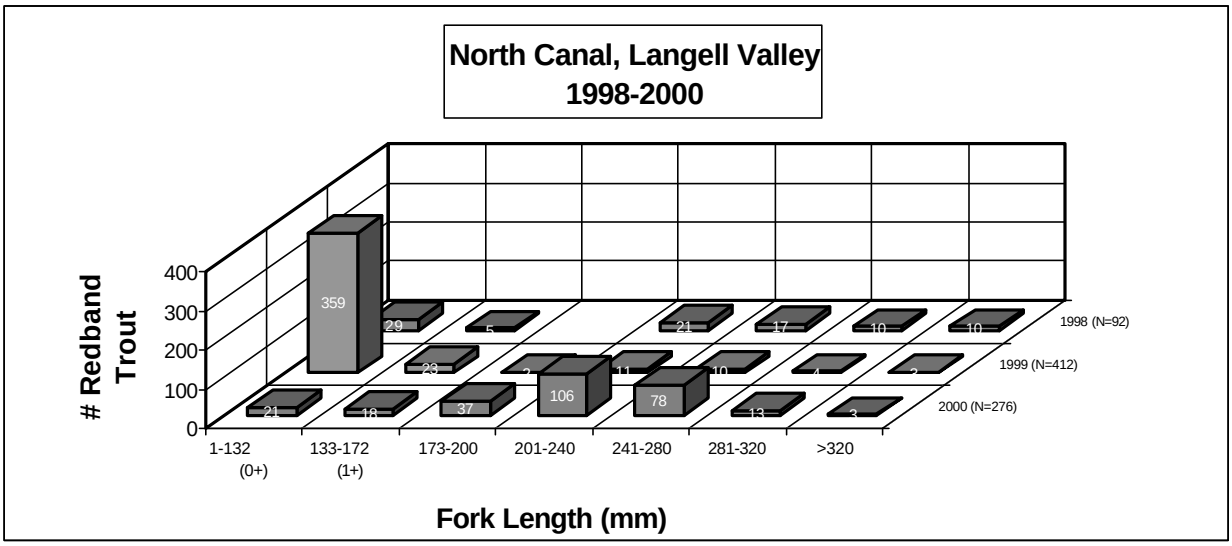

Figure 2. Length frequency of redband trout sampled from North Canal, Langell Valley, Oregon, 1998-2000.

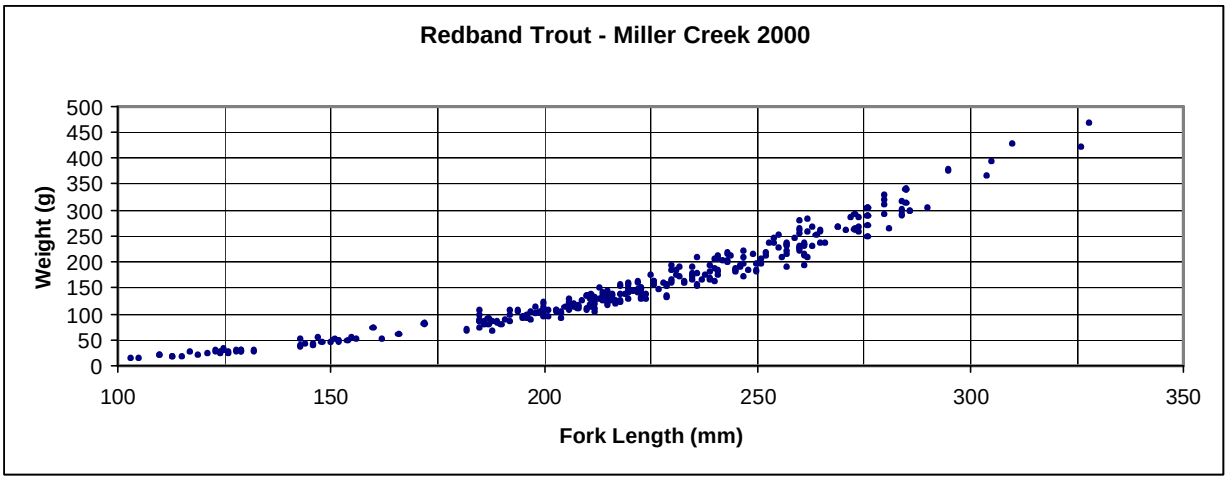

Figure 3. Length / weight relationship of redband trout sampled from North Canal, Langell Valley, Oregon, 2000.

Even though a large number of 0+ trout (N=359) were captured in 1999, a small number of 1+ trout (N=18) were captured in 2000 (Figures 2 & 4). One possible explanation is that most of the trout produced in 1999 migrated downstream of the North Canal by October of 2000, when canal sampling occurred.

In 2000, 237 (86%) trout were 2+ or older, compared to 30 (7%) in 1999, and 58 (39%) in 1998 (Figures 2 & 4). This difference may result from density dependant factors influencing larger trout in Miller Creek during low flow years. Between February 1998 and October 1999 there was only one month of low flows (2 cfs). In comparison, low flows occurred from November 1999 to March 2000, with an increase in flow beginning in April at the start of irrigation season. Larger trout may have resided and thrived in Miller Creek during high flows of 1998 and 1999, and then became overcrowded during low flows of winter and early spring 1999 and 2000. When flows were increased in April 2000, these larger trout may have dispersed downstream and were consequently entrained into the North Canal where they resided until October.

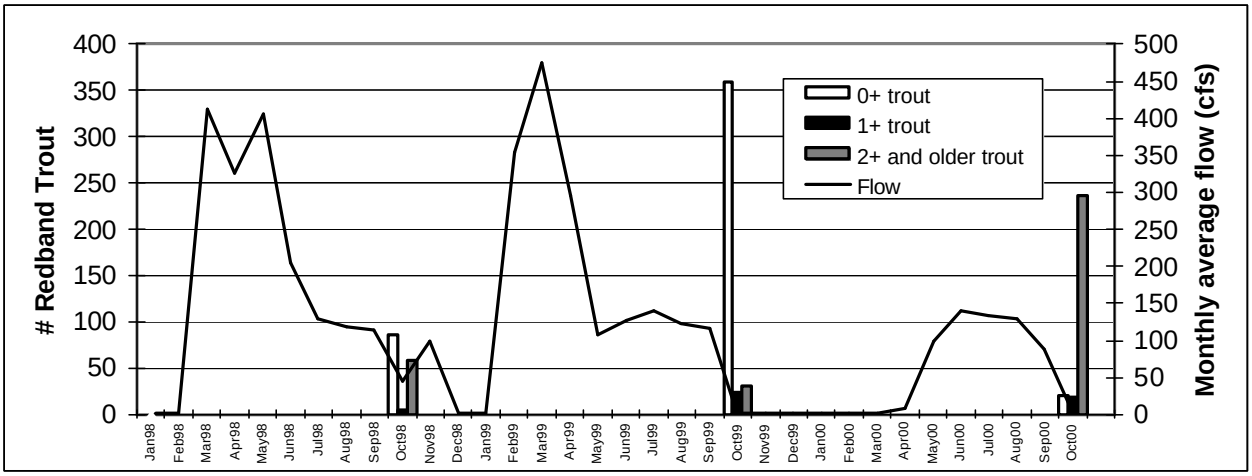

Figure 4. Number of redband trout captured in October during North Canal salvage, in relation to the average monthly flow exiting Gerber Reservoir, 1998-2000.

West Canal, Langell Valley Fish Survey

On October 11, fish sampling was conducted in the West Canal of Langell Valley. A total of six suckers (1 Klamath largescale, 5 unknown) were collected, ranging from 93 - 200 mm FL, with a mean of 120 mm, and a median of 108 mm.

A total of 14 species were encountered including: brown bullhead (*Ameiurus nebulosus*), pumpkinseed sunfish (*Lepomis gibbosus*), Sacramento perch (*Archoplites interruptus*), green sunfish (*Lepomis cyanellus*), largemouth bass (*Micropterus salmoides*), fathead minnow, yellow bullhead (*Ameiurus natalis*), black bullhead (*Ameiurus melas*), yellow perch, blue chub (*Gila coerulea*), speckled dace, unknown sculpin, unknown sucker, and Klamath largescale sucker.

The West Canal originates at Malone Diversion Dam. Water enters the reservoir during the irrigation season from controlled releases at Clear Lake Dam, approximately 10 miles upstream. At the end of the irrigation season, flow from Clear Lake is terminated and Malone Reservoir is drawn down over a period of several days. During draw down, water from the reservoir is diverted into the West Canal until the reservoir surface elevation is lower than the canal entrance, at which time the gates at Malone Dam are opened, allowing water to flow directly into the Lost River. A 1 1/4 inch avian wire mesh screen exists at the forebay of the West canal, however, this screen was in partial disrepair during 2000. It is unknown when fish became entrained into the canal, either during the irrigation season or during draw down of the reservoir.

Clear Lake Dam Salvage

On September 29, October 4 and 13, fish salvage was conducted below Clear Lake Dam. This salvage operation consisted of electrofishing the river channel from about 500 m downstream of the outlet tunnel of the dam into the tunnel outlet. Water was pumped from the tunnel to facilitate access and to improve salvage efficiency. A total of 587 suckers (492 shortnose, 65 Lost River, 30 unknown) were collected (Figure 5). Suckers ranged from 95 - 625 mm FL, with a mean of 259 mm, and median of 253 mm.

Species occurred in the following order of abundance from higher to lower: blue chub, Sacramento perch, shortnose sucker, green sunfish, brown bullhead, pumpkinseed sunfish, unknown sculpin, Lost River sucker, unknown sucker, unknown lamprey and largemouth bass. The one largemouth bass measured 260 mm and weighed 300 g. It is the first record of a largemouth bass being captured during salvage below Clear Lake Dam.

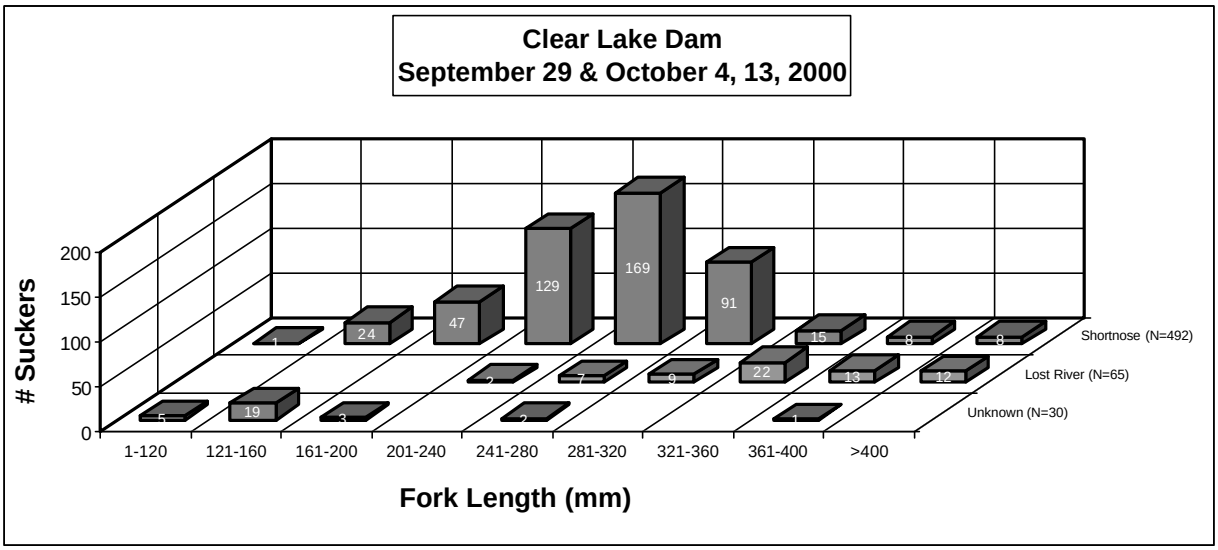

Figure 5. Length frequency of unknown, Lost River and shortnose suckers salvaged below Clear Lake Dam, California.

Reclamation installed a 76 m long by 9 m deep (tapering to 5 m at ends) net with 1.3 cm mesh (stretch measure) in the forebay area of the dam prior to the start of irrigation diversions. On August 18, 2000, Reclamation moved the net from the forebay area to an area in the reservoir ½ mile south of the dam. Three nets were tied together and stretched across the channel in Clear Lake Reservoir. These nets were about 250 m long, 5 – 9 m deep, and 1.3 – 2.5 cm mesh (stretch measure). Moving the block net was done to accommodate increased releases from Clear Lake, which could pull the forebay net into the dam outlet gate. The net is intended to prevent larger suckers from leaving Clear Lake through the dam outlet and is maintained throughout the irrigation season. There is a possibility of fish being trapped in the area between the net and dam at time of deployment, swimming under or jumping over the net, or small fish swimming through the mesh.

The net, first used in 1993, appeared to reduce the number of adult suckers (>240 mm) being entrained. Salvage operations collected 253 in 1992, compared to one in 1993 (Table 1). This decrease may also be due to differences in Clear Lake surface elevations. Very low elevations occurred during 1992 possibly concentrating fish near the dam, whereas higher elevations occurred in 1993 allowing fish to disperse throughout the reservoir. Numbers of adult suckers caught remained fairly low, from zero in 1994 to 14 in 1998, until 357 were captured in 2000. This increase is probably a result of moving the block net ½ mile south of the dam during the irrigation season. This area of reservoir is deep (>5m), providing preferred depth ranges for adult suckers. An unknown number of adult suckers were probably trapped between the dam and the repositioned net, with an unknown number becoming entrained through the outlet gates of the dam, of which 357 were recovered during salvage efforts. Another possibility for the increase in adult suckers below Clear Lake Dam is that the increased flow releases attracted

Table 1. Suckers salvaged below Clear Lake Dam, California, 1991 - 2000.

		Fork Length (mm)					
Date	**Total**	**1-120**	**121-160**	**161-200**	**201-240**	**>240**	**Release Site**
09/17/91	256	0	2	90	25	139	Crystal Lake Hat., CA & Dexter Hat., NM
07/01/92	354	0	1	22	35	253	Lost River, Malone Reservoir, OR
09/30/93	55	7	0	0	0	1	Anderson-Rose Dam, Tule Lake, CA
09/20/94	292	26	54	3	2	0	English Channel, Tule Lake, CA
10/02/95	34	0	24	8	0	2	Lost River, Stevenson Park, OR
10/04/96	51	7	26	7	6	5	Lost River, Olene Gap, OR
03/11/97	10	1	0	0	0	9	Lost River, Olene Gap, OR
10/15/97	33	0	5	10	8	10	Lost River, Olene Gap, OR
10/08/98	24	0	1	1	8	14	Lost River, Stevenson Park, OR
10/01/99	6	0	0	0	0	6	Lost River, Stevenson Park, OR
9/29&10/04,13/00	587	6	43	50	131	357	Lost River, Stevenson Park, OR

suckers from downstream locations to the base of the dam. However, sampling within the Lost River between Clear Lake Dam and Malone Reservoir indicates that there are only small, fragmented populations of suckers residing in this area. Therefore, if repositioning the net in 2001 is required, it may be desirable that immediate, intensive trapping of suckers occur between the repositioned net and the dam. Captured suckers could then be released into Clear Lake Reservoir on the opposite side of the block net.

Five suckers (4 Lost River, 1 shortnose) contained PIT tags that had been implanted at an earlier date (Table 2). The original tag date and location for one sucker is unknown (LR Male 342 mm). Three suckers were originally tagged in Clear Lake Reservoir near the dam during 1996. One sucker (LR Male 625 mm) was tagged on March 29, 1999 during sampling efforts conducted in the Lost River immediately below Clear Lake Dam. This sucker was released back into the same area it was captured from immediately after tagging. Salvage activities conducted in the fall of 1999 evidently did not capture this sucker. It was able to survive below Clear Lake Dam throughout the winter even though flows below Clear Lake Dam were reduced to 0 cfs and water quality degraded. However, it may have been stressed during this time period as indicated by its fork length, which was 14 mm shorter in 2000 compared to 1999. The three suckers that were originally tagged in Clear Lake Reservoir during 1996, and presumably resided there until 2000, grew 12, 81, and 142 mm.

Table 2. Suckers previously tagged with passive integrated transponder (PIT) tags and recaptured below Clear Lake Dam, California, 2000.

Species	**Sex**	**FL (mm)**	**Weight (g)**	**Recapture Date**	**Original Tag Date**	**Original Tag Location**	**Original FL (mm)**
Lost River	Male	342	375	9/29/2000	?	?	?
Lost River	Male	387	530	9/29/2000	10/30/1996	Clear Lake Reservoir at dam	306
Lost River	Female	575	1698	10/4/2000	9/24/1996	Clear Lake Reservoir at dam	563
Lost River	Male	625	2517	10/4/2000	3/29/1999	Lost River below Clear Lake Dam	639
Shortnose	Female	309	364	10/13/2000	10/8/1996	Clear Lake Reservoir at dam	167

Approximately 25 adult suckers were captured using electroshockers and dip nets from pooled areas in the meadow adjacent to the Lost River downstream of Clear Lake Dam. Tall grass in the meadow made locating stranded suckers difficult. As a result, suckers may have been

missed. These pooled areas had become isolated from the Lost River when flow from Clear Lake Dam was decreased from more than 500 cfs to 0 cfs. Flows were reduced at a rate of approximately 100 cfs every hour to allow suckers time to access permanent water. Water receded from the meadow into the river channel when flow was approximately 400 cfs. Since this rate of flow reduction was not very effective in preventing sucker stranding, flow releases less than 400 cfs from Clear Lake Dam would prevent inundation of the meadow area and avoid stranding. If more than 400 cfs is released, a more gradual reduction of flow may prevent stranding of suckers in the meadow, and a more intensive and immediate search for stranded suckers may be required.

Klamath Irrigation District Salvage

Salvage operations began within Klamath Irrigation District (KID) canals on October 16 and continued intermittently for 16 days until November 7 (Appendix 2). Sixty-one different sites were salvaged with several being revisited two or more times (Figure 7 & Appendix 1). Five new locations were added to the regular sampling sites and coverage at two existing sites was expanded. A total of 8,080 suckers (922 shortnose, 25 Lost River, 651 Klamath largescale, 6,470 unknown) were salvaged ranging in size from 52 - 440 mm FL (Figure 6 & 8).

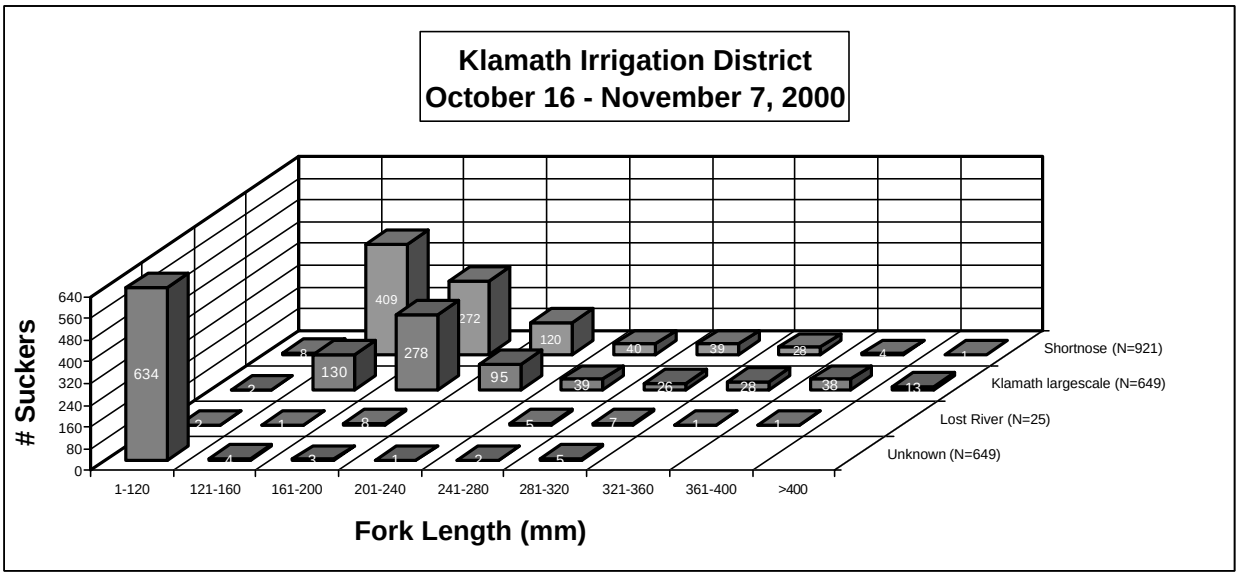

Figure 6. Length frequency of suckers (all species) measured during salvage in Klamath Irrigation District, Oregon.

Figure 6 shows length frequencies for unknown, Klamath largescale, shortnose and Lost River suckers. Most suckers <120 mm were not identified to species. Unknown suckers dominated the 1 - 120 mm size class. Klamath largescale suckers dominated the >360 mm size class. Shortnose suckers dominated the 121 - 160 mm size class with 409 individuals measured. Approximately equal numbers of Klamath largescale and shortnose suckers ranged from 161 – 360 mm. Lost River suckers were most abundant, but not dominant, in the 161 - 200 mm size class with 8 individuals measured.

The dominant age class in 2000 were young-of-the-year (0+, <120 mm), comprising 80% of all suckers from KID and TID (Table 3). There was also a substantial number of 1+ suckers captured, comprising 14% of all suckers salvaged.

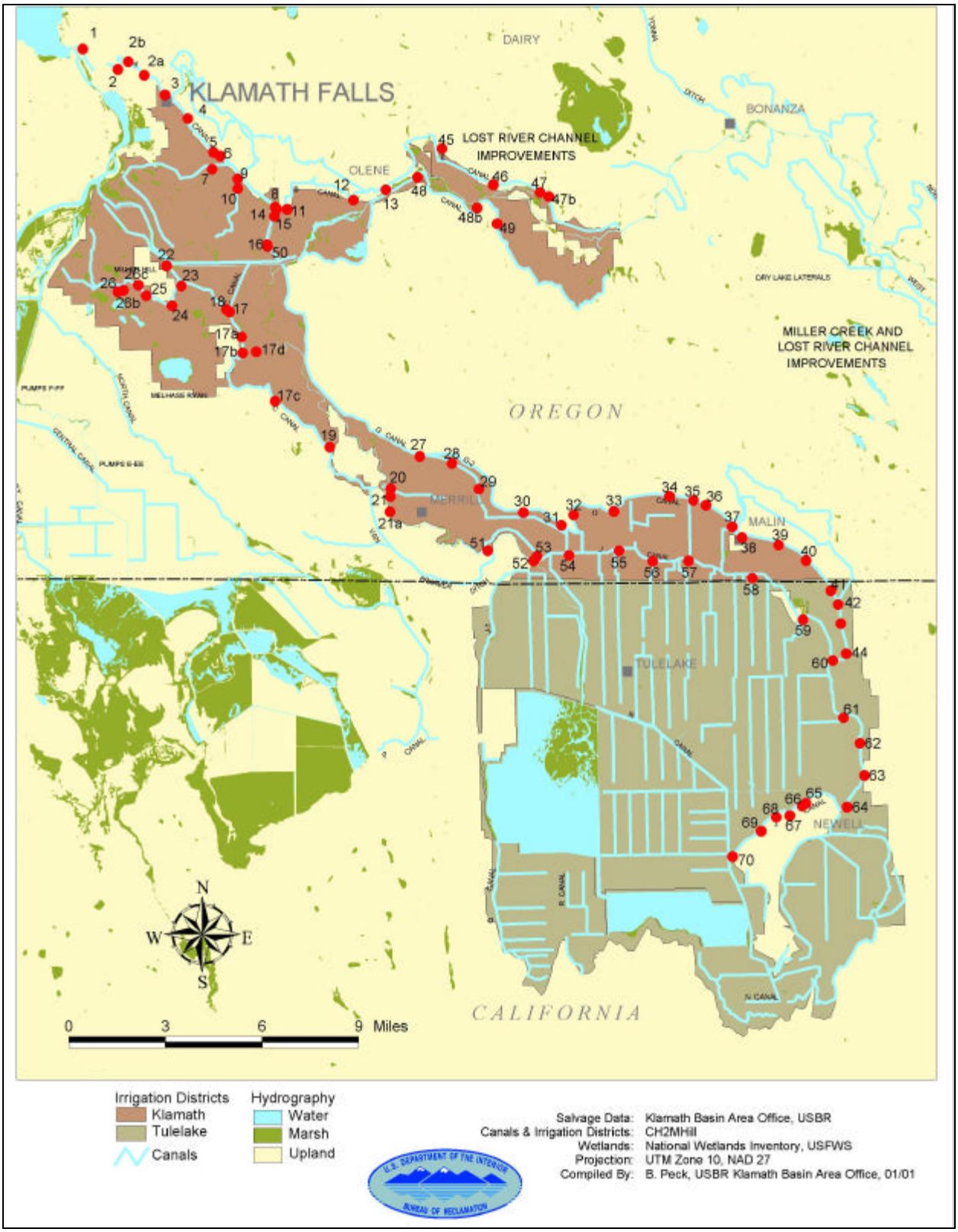

Figure 7. Canal salvage sites in Klamath and Tulelake Irrigation Districts, 2000.

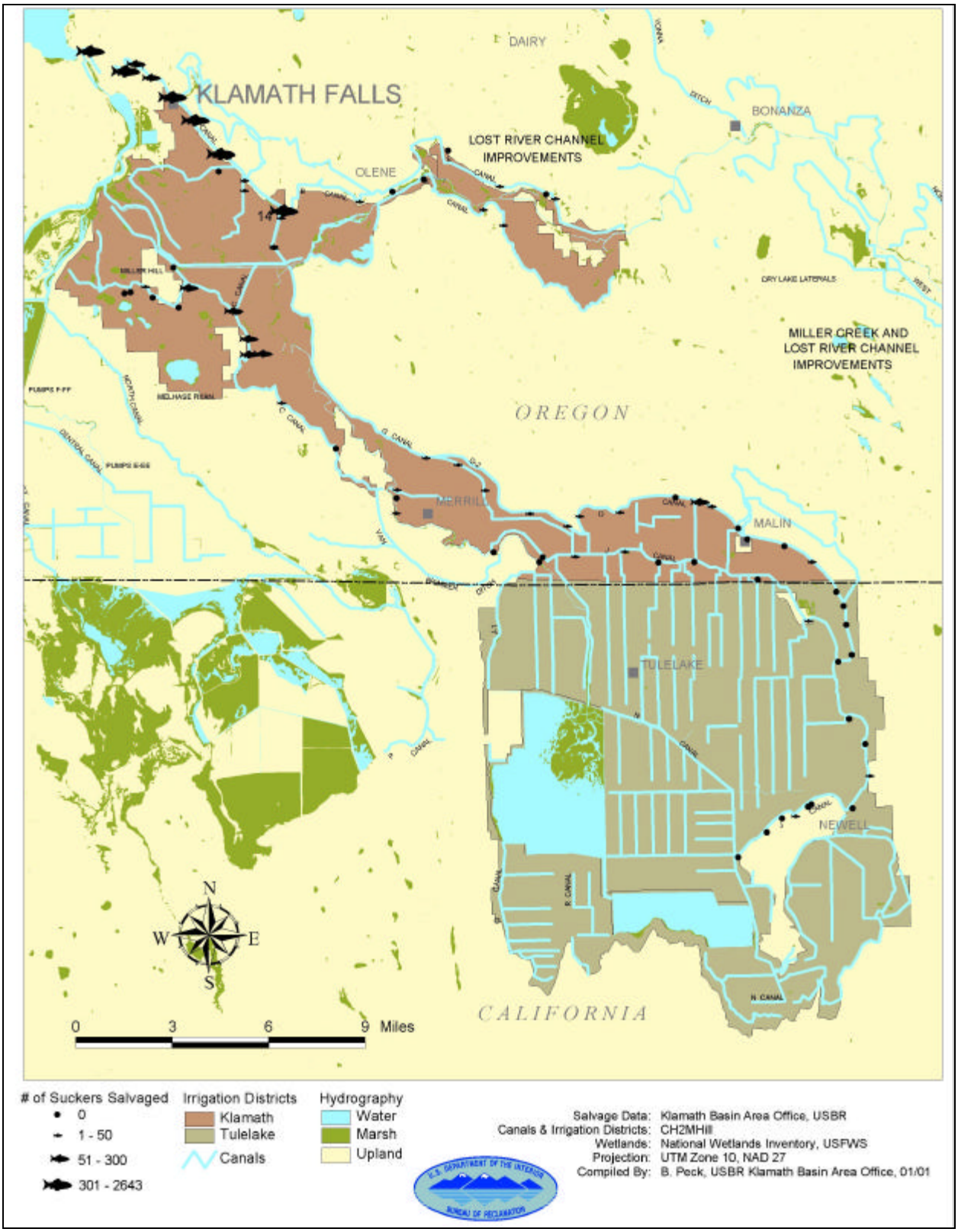

Figure 8. Distribution and abundance of suckers salvaged from Klamath and Tulelake Irrigation District canals, 2000.

Table 3. Annual sucker salvage totals from Klamath and Tulelake Irrigation Districts, 1991 - 2000.

Year	Salvage total (KID + TID)	Dominant age class 0+	Dominant age class 1+	Suckers >240 mm	Recorded sucker mortalities (#)	Percent mortality (%)
1991	3,236	x		24	-	-
1992	2,612		x	26	-	-
1993	788	x		26	-	-
1994	218		x	1	-	-
1995	3,935	x		29	-	-
1996	11,166	x		74	-	-
1997	2,383		x	378	82	3.4
1998	2,717	x		237	35	1.3
1999	26,928	X		425	64	0.2
2000	8,144	X		277	82	1.0

Relative abundance of salvaged suckers from 1994 to 2000 is shown in Figure 9. Abundance of Klamath largescale suckers has increased from a low of 6% in 1994 to a high of 78% in 1996, but has since declined to 41% in 2000. Inversely, abundance of shortnose suckers has decreased from a high of 79% in 1994 to a low of 20% in 1996, but has since increased to 58% in 2000. A dominance shift from shortnose to Klamath largescale suckers occurred during 1996. A major fish kill occurred on Upper Klamath Lake during the late summer of 1996 killing at least 6,000 suckers. This fish kill may have adversely affected shortnose suckers more than Klamath largescale suckers, thereby causing the dominance shift of salvaged suckers. In 2000, the dominant species shifted back to shortnose suckers. This increase in shortnose suckers is mostly from 1+ in 2000 (Figure 10) produced from a very strong year class in 1999 (Figure 11 – unknown suckers). Lost River sucker abundance has ranged from a high of 15% in 1994 to a low of 1% in 2000 (Figure 9). The high percentage of Klamath largescale suckers in the canal salvage is unusual because largescale numbers are relatively small in Upper Klamath Lake. The more riverine largescale sucker may reside in the Link River and be attracted to the flow in the A canal.

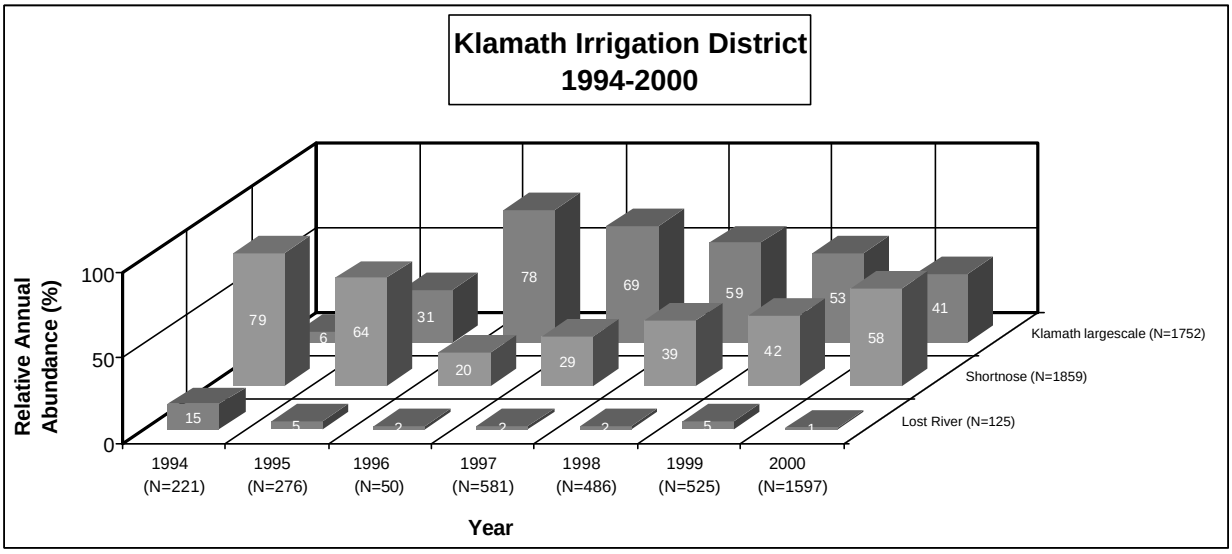

Figure 9. Species composition of identified suckers salvaged from the Klamath Irrigation District, 1994 - 2000.

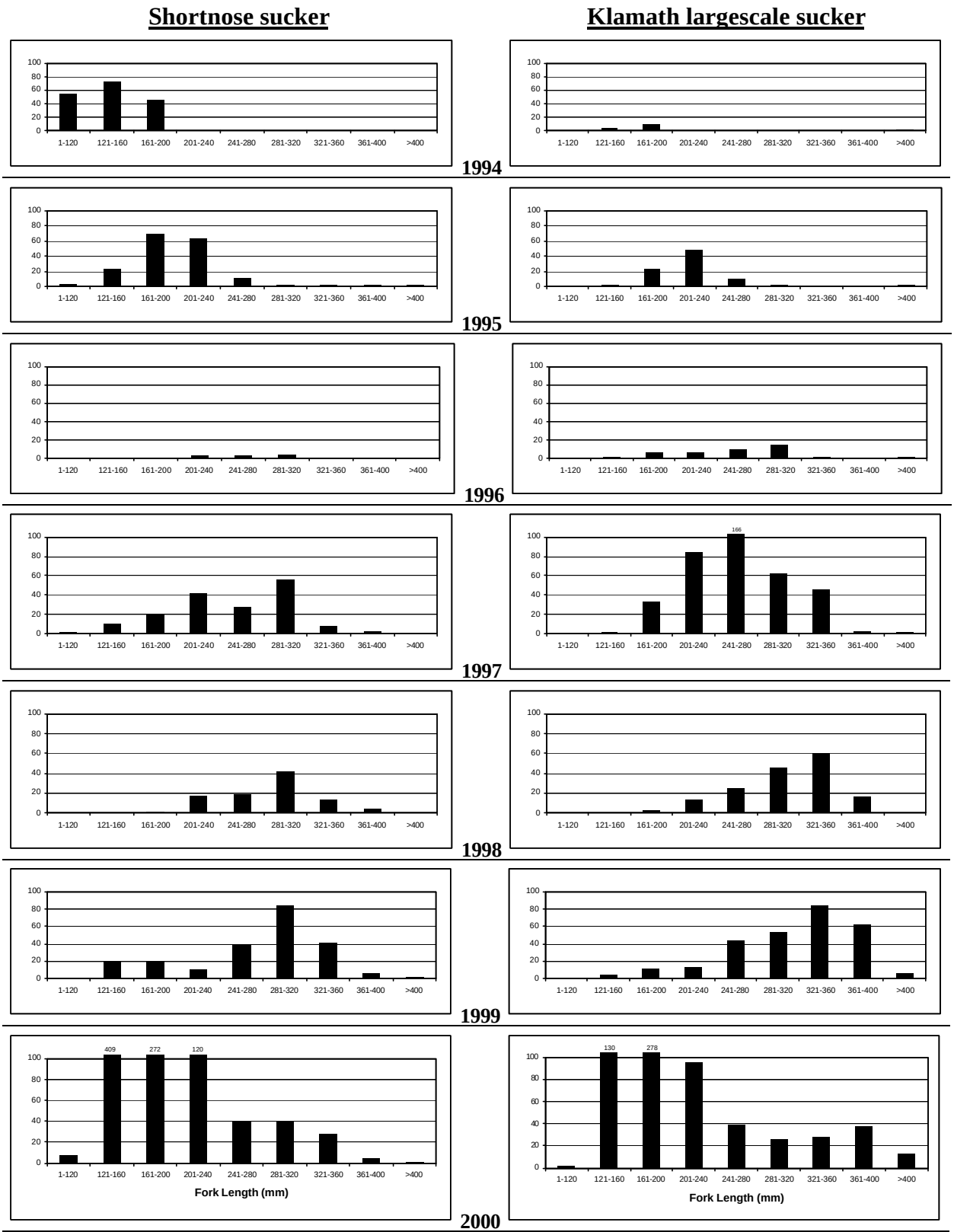

Figure 10. Length frequency of shortnose and Klamath largescale suckers from 1994-2000. The Y axis represents number of suckers.

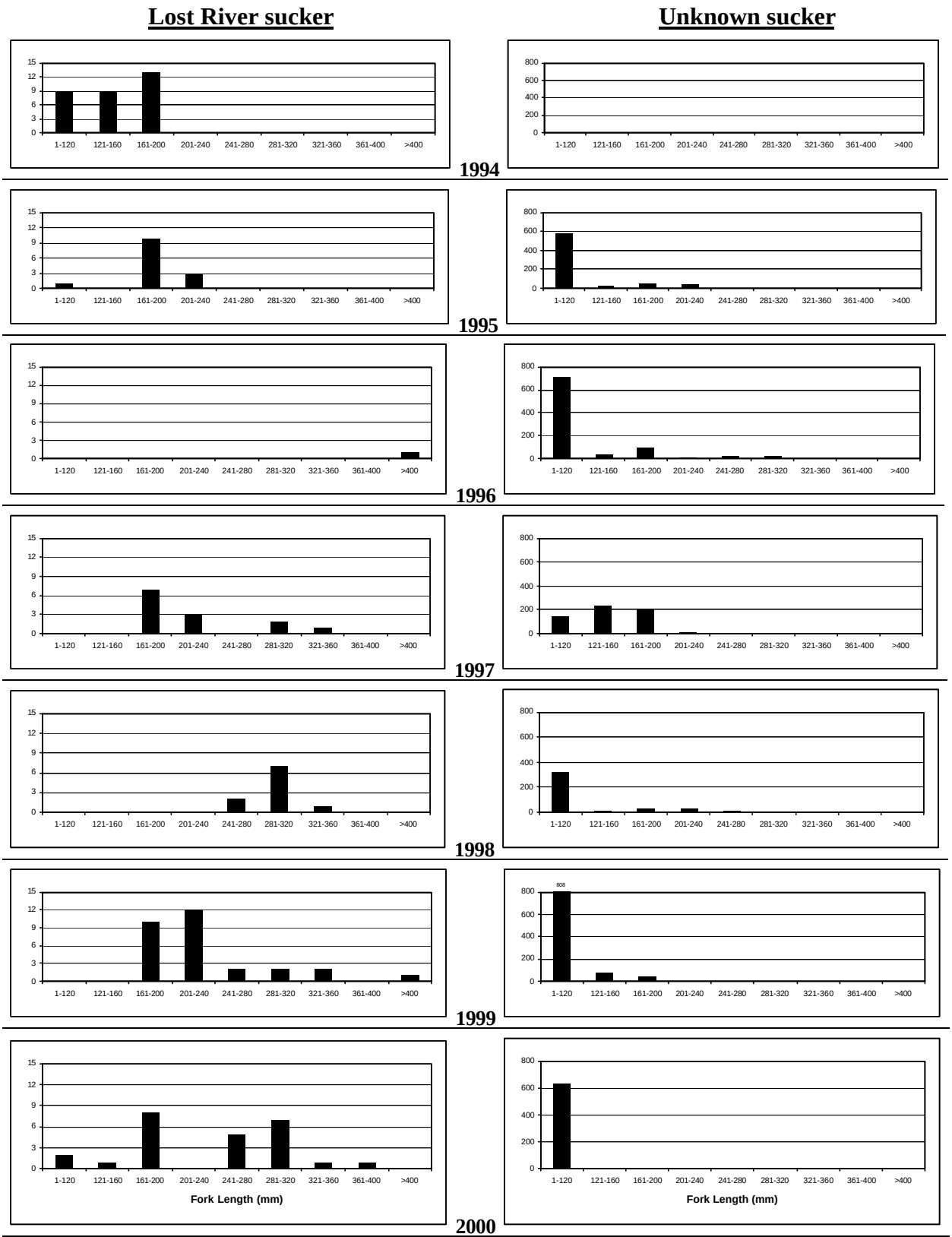

Figure 11. Length frequency of Lost River and unknown suckers from 1994-2000. The Y axis represents number of suckers. Note differences in Y axis scales between species.

Two salvaged suckers had previously been implanted with a PIT tag. One male Klamath largescale sucker (FL 374 mm) was recaptured from site 2a in the A-Canal on October 25, 2000. This sucker was originally captured and PIT tagged on November 12, 1999 during salvage at site 2a (FL 349). The Biological Resources Division of the U.S. Geological Survey also had recaptured it in the fish ladder at the Sprague River Dam on March 27, 2000 (FL 357). At this time it was probably migrating up the Sprague River to spawn. Unfortunately, this sucker died during salvage efforts in 2000. Another male Klamath largescale sucker (FL 411 mm) was recaptured from site 1 in the A-Canal on October 31, 2000. This sucker was previously captured and PIT tagged during salvage at site 2 in the A-Canal on October 30, 1998 (FL 371) and had been released into Upper Klamath Lake at Barkley Springs.

In 2000, a total of 3,675 suckers were found at the eight sites required to be salvaged by the BO (Table 4). This represents the third largest total number of salvaged suckers since salvage began. Site 14, at the C-canal drop, contained the largest number of salvaged suckers at 2,634.

Table 4. Suckers found at eight sites required to be salvaged by the July 22, 1992 Biological Opinion.

Location	Site	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
A-Canal headworks and tunnel	1	2,247	2,611	196	37	277	3,847	456	377	1,757	851
C-Canal Drop	14	207	2	0	0	280	0	0	485*	1,284	2,634
B-Canal area	11	259	0	0	21	0	204	5	8	46	1
Upper C-Canal	16	110	5	0	3	12	4	0	1	41	16
G-Drop	50	162	4	0	1	41	-	2	0	1	3
D-3 lateral	20	44	0	488	0	3	24	0	5	1,143	2
C-4 lateral	23	31	4	39	0	421	3	15	117	1,422	168
J-Canal - check 8	60	106	0	0	0	347	20	2	3	214	0
Total		3,166	2,626	723	62	1,381	4,102	480	996	5,908	3,675

* includes suckers in fish kill (n=322), 163 suckers were recovered alive from site 14.

Classifying years into poor (poor Upper Klamath Lake water quality and/or low lake elevations) and good (good water quality and/or higher lake elevations) categories reveals possible patterns in distribution / abundance of suckers salvaged from the canal system (Table 4). Poor years include 1991 (low elevation), 1992 (low elevation), 1994 (low elevation), 1996 (water quality, major fish kill), and 1997 (water quality, major fish kill). Good years include 1993, 1995 (minor fish kill late in the irrigation season), 1998, 1999, and 2000. During poor years, 84% of salvaged suckers were concentrated at site 1, near the headgates of the A-Canal. During good years, 27% of suckers were salvaged at site 1. This indicates that suckers remained or were able to survive at site 1 during poor years, while during good years suckers were able to distribute throughout the canal system. This may also indicate that larger (1+ and older) suckers may better be able to remain near the point of diversion. Larger (1+) suckers were dominant in poor years 1992, 1994, and 1997 (Table 2).

A total of 11 redband trout were collected of which 10 were measured (Figure 12). Trout ranged from 112 - 735 mm FL, with a mean of 409 mm, and median of 500 mm.

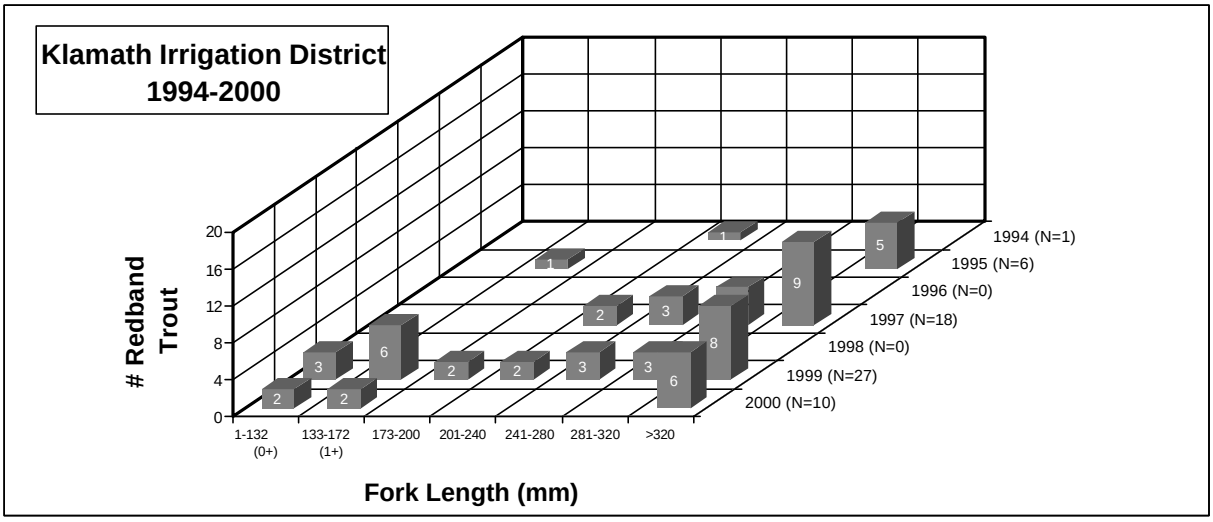

Figure 12. Length frequency of redband trout salvaged in Klamath Irrigation District, Oregon, 1994-2000.

Species occurred in the following order of abundance from higher to lower: blue chub, fathead minnow, tui chub (*Gila bicolor*), yellow perch, sculpin, unknown sucker, shortnose sucker, Klamath largescale sucker, speckled dace, goldfish (*Carassius auratus*), pumpkinseed sunfish, Lost River sucker, redband trout, largemouth bass, and lamprey. Approximately four juvenile largemouth bass were sampled at site 2 on the A canal (Figure 7). This is the first record of largemouth bass from the A canal. All of the bass probably originated from the northern portion of Upper Klamath Lake. Tens of thousands of juvenile and adult yellow perch were sampled from multiple sites throughout the canal system, an increase from past years. Increased numbers of both yellow perch and largemouth bass may indicate that these populations are increasing in Upper Klamath Lake.

Tulelake Irrigation District Salvage

Salvage operations occurred within TID canals on November 27 and December 1, 2000. A total of 20 sites were visited, with salvage occurring at 17 sites (Figure 7 and Appendix 1 & 2). Sites 53, 66, and 68 were dry and therefore were not salvaged.

A total of 64 unknown suckers and one shortnose sucker were salvaged in TID canals (Appendix 2). Measured suckers (n=49) ranged from 59 - 133 mm FL, with a mean of 87 mm, and median of 84 mm (Figure 13). Young-of-the-year suckers (n=48) comprised 98% of the total, and 2% (n=1) were age 1+.

Fish species were encountered in the following order of abundance from higher to lower: fathead minnow, blue chub, tui chub, yellow perch, goldfish, pumpkinseed sunfish, brown bullhead, unknown sucker, largemouth bass, and shortnose sucker.

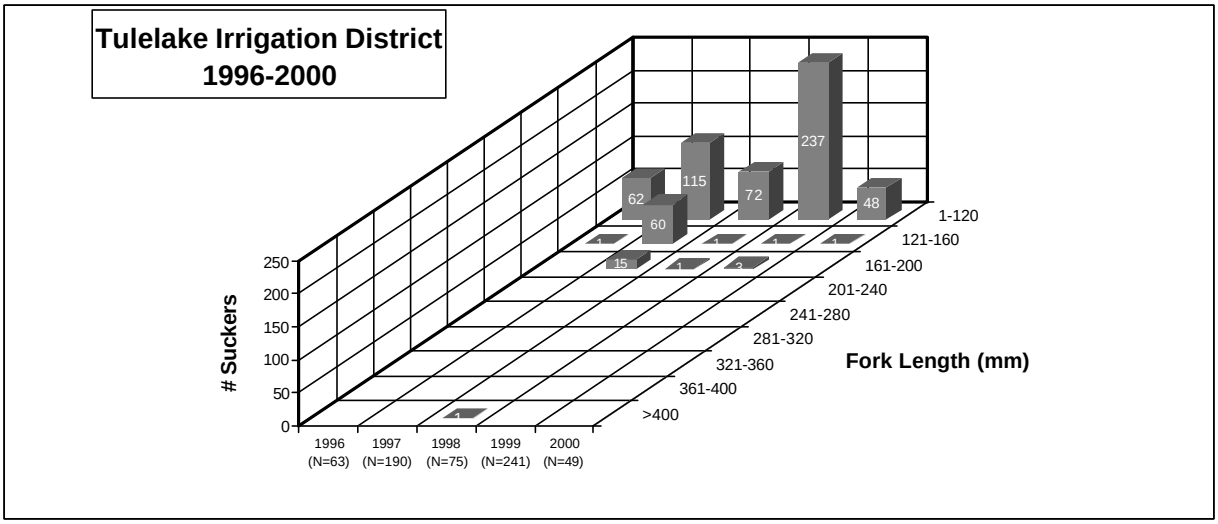

Figure 13. Length frequency of suckers salvaged in Tulelake Irrigation District, 1996-2000.

INCIDENTAL TAKE

The 1992 Biological Opinion allows up to 125 Lost River and shortnose suckers to be taken during salvage activities. No known sucker or trout mortalities occurred during the TID and West Canal salvages. One trout mortality was observed during the North Canal sampling effort. Eleven suckers (10 shortnose, 1 unknown) died during Clear Lake Dam salvage. Eighty-two (1.0% of total) suckers (15 shortnose, 2 Lost River, 27 Klamath largescale, 38 unknown) and 1 redband trout (9.1% of total) died during KID salvage operations.

Stress on fish was minimized by frequently transferring fish in buckets filled with water from the salvage site to the transport truck. Portable air pumps were attached to some of the buckets. Multi-layered artificial slime and kiln dried salt (no additives, 5 ppt) were added to the holding tank to further reduce stress on transported fish. Artificial slime helps protect fish from bacterial infection while the salt equalizes osmotic pressure, reduces lactic acid production in the fish and can kill external parasites. A 4 ft section of PVC pipe, cut in half lengthwise, was used as a chute to convey fish from the tank directly to the release water.

REFERENCES

United States Bureau of Reclamation. 1992. Salvage of suckers from the Klamath Project, dated January 7, 1992. U.S. Bureau of Reclamation, Klamath Falls, Oregon.

United States Fish and Wildlife Service. 1992. Biological Opinion on the long term operation of the Klamath Project. 1-1-92-F-34. Region 1, Portland, Oregon.

Appendix 1. Klamath Project salvage site descriptions.

Site #	Canal/ River	Location	Road	Check #		Site #	Canal/River	Location	Road	Check #
1	A	Headworks inlet & tunnel				51	J	Anderson-Rose Dam		
2	A	Tunnel outlet to KUHS area				52	J	Check 1		
2A	A	1/4 mile upstream of bridge	Main			53	J1	South end of siphon		
2B	A	Esplanade Bridge 1/4 mile down				54	J	Check 2		
3	A	YMCA (1/4 mile downstream and under br)				55	J	Check 3		
4	A	KFC (1/4 mile downstream and under br)	S. 6th			56	J	Check 4		
5	A	1/2 mile downstream and under bridge	Homedale			57	J	Check 5		
6	A3	Rd. up to headworks	Villa			58	J	Check 6 (south of Rd.)	Stateline	
7	A3	West of Rd.	Homedale			59	J	Check 7		
8	A	Tail-end, above C-drop				60	J	Check 8 (D&J canal confluence)	County Rd. 104	
9	A4	A-canal detention basin- north end				61	J	Check 9		
10	A4	A-canal detention basin- south end				62	J	Check 10		
11	B	Below check	Reeder			63	J	Check 11		
12	B	1/2 mile west of Olene (near wooden br)				64	J	Check 12		
13	B	Olene Flume (north end)				65	J	Check 13		
14	C	C-drop (Cell Tech)				66	J	Culvert (east of Hwy)	Hwy 139	
15	C	Pool downstream of harvest screens				67	J	RR bridge (west of Hwy)	Hwy 139	
16	C	Above G-canal drop				68	J	Check 14 (normally drained)		
17	C	C4 confluence [ditchtender house]				69	J	Culvert @ Rd.	County Rd. 112	
17A	C	Check C7		C51036		70	J	Pump 24 (tailend of J-canal)		
17B	C	O'Conner check dowm to bend in rip rap	O'Conner	C51049		90	Link River	Immediately down of Link R. Dam		
17C	C	Matney Check down ro bend in rip-rap		C51058		92	Link River	Side channel		
17D	C7	Matney Rd.				94	Link River	East canal		
18	C4	C-canal confluence (west side)				96	Link River	West canal		
19	C	Check 1/2 mi. South of bridge	Chin	C51097		100	Lost River	Downstream of Clear L. Dam to head of canyon		
20	D3	Adam's Flume area (east lat.)	Anderson			110	Miller Creek	Pool below Gerber Dam		
21	D1	Adam's Flume area (south lat.)	Anderson			120	North Canal	Headgate to Farrington's check		
21A	D1	South lateral - 1/4 mile below site 21		C6103		120A	North Canal	Headgate to Kents		
22	C4	Miller Hill pumping plant				120B	North Canal	From bridge through Kents		
23	C4	Mac check	Spring Lake	C44027		120C	North Canal	From Kents through R. Smiths downstream		
24	C4	Check 1/4 mi. south of Rd.	Old Midland	C44037		120D	North Canal	From R. Smiths downstream to Farringon's check		
25	C4	Check 1/4 mile north of Rd.	Old Midland	C44049		121	North Canal	Farrington's check to driveway		
26	C4	1/8 mile west of Rd. (before wooden br.)	Tingley	C44063		121A	North Canal	Farrington's check - downstream pool		
26b	C4	1/4 mile west of Rd. (after wooden br.)	Tingley	C44066.5		121B	North Canal	Farrington's check - Gerber Rd		
26c	C4	Check 1/4 mile east of Rd.	Tingley	C44057		122	North Canal	Driveway to Gerber Rd		
27	D	D&G-canal area	Hill			123	North Canal	Gerber Rd to Randall's check		
28	D	Check 2		C61010		123A	North Canal	Gerber Rd to Flume		
29	D	Check 3		C61016		124	North Canal	Randall's check to Wood flume		
30	D	Check 4	Dodd's Holl	C61029		125	North Canal	Downstream of Wood flume		
31	D	Check 5 (Adam's)		C61041		126	West Canal	Malone Dam to 1st cross @ W. Langell Valley Rd		
32	D	Check 6 (Coverengton sp?)		C61049		127	West Canal	1st crossing to 2nd W. Langell Valley Rd crossing		
33	D	Check 7 (above Rd. @ D14)	Payger	C71060		128	West Canal	2nd W. Lang V Rd cross to 1st check (Firehouse)		
34	D	Check 8 (behind locked gate, west of Rd.)	Harpold	C71077		129	West Canal	1st check to 2nd check (Hammerich)		
35	D	Tunnel bridge	Micha			130	West Canal	2nd check to 3rd check (Biaggi)		
36	D	Check 9 (below SVID pumps)		C71087		131	West Canal	3rd check to 3rd W. Langell Valley Rd crossing		
37	D	Check 10		C71093		132	West Canal	3rd W. Lang Val Rd crossing to 4th check (Smith)		
38	D	Check 11 (Malin)				133	West Canal	4th check to 5th check (Steel)		
39	D	Check 12		C71108		134	West Canal	5th check to Cheese Factory Rd		
40	D	Check 13		C71113		135	West Canal	Pine check to W. Langell Valley Road		
41	D	Check 14 (above Rd.)	Stateline	C71121						
42	D	Check 15 (below Rd.)	Stateline	C71129						
43	D	House with stone wall		C71132						
44	D	Driveway @ bull pasture		C71135						
45	E	1st crossing	N Poe Vall							
46	E	2nd crossing	N Poe Vall							
47	E	Crossing near dairy	N Poe Vall							
47b	E	1/4 mile south on Lost R. Ranch, thru gate	N Poe Vall							
48	F	1 mi. east of Olene flume NW of house	S Poe Valley	C85						
48b	F	1/2 mi. east on road to pumping plant	S Poe Valley	C815						
49	F	SW of Reiling Rd. crossing thru metal gate	S Poe Valley	C827						
50	G	G-drop @ C-canal								

Appendix 2. Klamath and Tulelake Irrigation District salvage data, 2000.

Date	Site #	Canal	Total	1-120	121-160	161-200	201-240	241-280	281-320	>320	Deep	Dry	Effort
10/16/2000	6	A3	1			1							2047
10/16/2000	7	A3										Y	
10/16/2000	9	A4	3	3									675
10/16/2000	10	A4	7	7									842
10/18/2000	18	C4	75	40									343
10/18/2000	20	D3	2	2									86
10/18/2000	21	D1											143
10/18/2000	22	C4											43
10/18/2000	23	C4	60	40		2							660
10/18/2000	25	C4											83
10/18/2000	26	C4											113
10/18/2000	21A	D1	3	3									102
10/18/2000	26B	C4											124
10/18/2000	26C	C4	5	5									258
10/19/2000	11	B	1	1									243
10/19/2000	18	C4	11	1									204
10/19/2000	19	C											224
10/19/2000	23	C4	102	20	3	2	1						1450
10/19/2000	17A	C	76	22									576
10/19/2000	17B	C	67	20									809
10/19/2000	17D	C7	15	15									254
10/20/2000	12	B	37	20	1								558
10/20/2000	13	B										Y	
10/20/2000	17	C	14	14									600
10/20/2000	23	C4	6										390
10/20/2000	24	C4											244
10/20/2000	17B	C	83			1							722
10/20/2000	17C	C	109	21									1140
10/23/2000	27	D	16	16									547
10/23/2000	17B	C	21		1								771
10/23/2000	17C	C	63										687
10/24/2000	27	D	6	6									437
10/24/2000	39	D											154
10/24/2000	40	D	22	20									391
10/24/2000	43	D											105
10/24/2000	42	D											100
10/24/2000	41	D											144
10/24/2000	44	D											195
10/24/2000	45	E											208
10/24/2000	46	E	1	1									145
10/24/2000	47	E											103
10/24/2000	48	F											157
10/24/2000	49	F	1	1									167
10/24/2000	17C	C	33										1062
10/24/2000	47B	E	1	1									44
10/24/2000	48B	F	44	19		1							565
10/25/2000	4	A	51	10	8	12	1	1	1				1009
10/25/2000	5	A	249	19	24	41	5	2					1996
10/25/2000	2A	A	51	4	9	7	5	5	5	16			969
10/25/2000	2B	A	52	3	3	12	8	8	4	14			654
10/26/2000	2	A	89	20	9	8	1						2360
10/26/2000	3	A	560	21	30	8	1						3559
10/26/2000	4	A	379	2	31	21	1						2327
10/27/2000	14	C	2635	23	15	3							
10/27/2000	15	C	13	6	5	2							1248
10/30/2000	28	D	11	11									597
10/30/2000	29	D	4	4									1045
10/30/2000	30	D	4	4									676
10/30/2000	31	D	28	20									144
10/30/2000	32	D	43	20									602
10/30/2000	33	D	11	11									292
10/30/2000	34	D											592
10/30/2000	35	D	67	20	3								569
10/30/2000	36	D	7	7									275

10/30/2000	38	D										Y	
10/30/2000	37	D										Y	
10/31/2000	1	A	407	25	47	51	24	3	3	8			4459
10/31/2000	2	A	115	20	16	17	8	3	9	2			765
10/31/2000	2A	A	58	9	4	7	3	5	13	17			833
10/31/2000	2B	A	108	20	16	30	10	4	8	9			1502
11/1/2000	1	A	25	1	7	6	5	1		3			
11/1/2000	2	A	525	20	26	25	6	7	2	5			11566
11/2/2000	1	A	419	3	108	53	38	2	4				24538
11/2/2000	2A	A	29	4	1		3	1	3	17			
11/3/2000	5	A	422	20	114	170	57	28	9	6			5584
11/3/2000	8	A	2	1	1								380
11/3/2000	16	C	16	14					1	1			658
11/3/2000	50	G	3	2	1								363
11/6/2000	2	A	66	2	5	2	1	1		2			1043
11/6/2000	3	A	461					2	2				2792
11/6/2000	2A	A	12		2	5			1	3			999
11/6/2000	2B	A	103	1	11	18	13	6	7	11			1228
11/7/2000	5	A	170	1	44	57	24	8	4	2			13191
KID Total			**8080**	**646**	**545**	**562**	**215**	**87**	**76**	**116**			

Date	Site #	Canal	Total	1-120	121-160	161-200	201-240	241-280	281-320	>320	Deep	Dry	Effort
11/27/2000	51	J											214
11/27/2000	52	J											514
11/27/2000	53	J										Y	
11/27/2000	54	J	7	7									159
11/27/2000	55	J	10	9	1								370
11/27/2000	56	J											255
11/27/2000	57	J											94
11/27/2000	58	J											150
11/27/2000	59	J	11	11									232
11/27/2000	60	J											83
11/27/2000	61	J											46
11/27/2000	62	J											39
11/27/2000	63	J	36	20									233
11/27/2000	64	J											32
11/27/2000	65	J											59
11/27/2000	66	J										Y	
11/27/2000	67	J	1	1									33
11/27/2000	68	J										Y	
11/27/2000	69	J											66
11/27/2000	70	J											141
12/1/2000	51	J											864
TID Total			**65**	**48**	**1**								

Appendix 2. Klamath and Tulelake Irrigation District salvage data, 2000 (continued).